

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Currently amended): A torque sensor where a first rotary shaft and a second rotary shaft are disposed on a common axial line, with the first rotary shaft and the second rotary shaft being coupled together by a torsion bar, and which detects torsional torque applied between the first rotary shaft and the second rotary shaft, the torque sensor comprising:

magnetic field generating means disposed in a center area along the common axial line, the magnetic field generating means includes at least one permanent magnet magnetized in a radial direction around the common axial line, the magnetic field generating means generating that generates a magnetic field in the radial direction around the common axial line;

magnetic field varying means that includes first, second, third, and fourth magnetic field varying components and two outer peripheral cylinders of magnetic material, where the first and second magnetic field varying components are disposed in the center area to surround the magnetic field generating means, the third and fourth magnetic field varying components are disposed in adjoining areas to the center area, and said magnetic field varying means that varies, in response to the relative rotation between the first rotary shaft and the second rotary shaft, varying the a relative direction and magnitude of a detection portion of detected magnetic flux from the magnetic field generating means flowing between the outer peripheral cylinders along an axis parallel to along the common axial line from the magnetic field generating means in response to the relative rotation between the first rotary shaft and the second rotary shaft; and

magnetic sensor means that detects the detection portion of detected magnetic flux,

wherein the magnetic sensor means generates an output signal whose polarity changes in response to the relative direction of the detection portion of detected magnetic flux and whose magnitude changes in response to the magnitude of the detection portion of detected magnetic flux.

Claim 2 (Original): The torque sensor of claim 1, wherein the magnetic field generating means comprises at least one ring-shaped permanent magnet disposed around the common axial line, and the permanent magnet is magnetized in the radial direction around the common axial line.

Claim 3 (Original): The torque sensor of claim 1, wherein the magnetic field generating means comprises plural permanent magnet plates disposed around the common axial line, and the magnetic field is generated by these permanent magnet plates.

Claim 4 (Canceled).

Claim 5 (Currently amended): The torque sensor of claim ~~[[4]]~~ 1, wherein ~~the outer peripheral cylinder includes a first outer peripheral cylinder and a second outer peripheral cylinder disposed along the common axial line, the first outer peripheral cylinder and the second outer peripheral cylinder are constructed such that the detected magnetic flux flows between them, and~~ the magnetic sensor means is disposed between the outer peripheral cylinders along the axis parallel to the common axial line such that the detection portion of detected magnetic flux passes directly through the magnetic sensor means.

Claim 6 (Currently amended): ~~The A torque sensor of claim 5~~ where a first rotary shaft and a second rotary shaft are disposed on a common axial line, with the first rotary shaft and the second rotary shaft being coupled together by a torsion bar, and which detects torsional torque applied between the first rotary shaft and the second rotary shaft, the torque sensor comprising:

magnetic field generating means that generates a magnetic field in the radial direction around the common axial line;

magnetic field varying means that varies, in response to the relative rotation between the first rotary shaft and the second rotary shaft, the direction and magnitude of detected magnetic flux flowing along the common axial line from the magnetic field generating means;

an outer peripheral cylinder that rotates together with the second rotary shaft, wherein the magnetic field varying means includes plural magnetic field varying means, and these plural magnetic field varying means are disposed along the common axial line on an inner periphery of the outer peripheral cylinder; and

magnetic sensor means that detects the detected magnetic flux,

wherein the magnetic sensor means generates an output signal whose polarity changes in response to the direction of the detected magnetic flux and whose magnitude changes in response to the magnitude of the detected magnetic flux,

wherein the outer peripheral cylinder includes a first outer peripheral cylinder and a second outer peripheral cylinder disposed along the common axial line, the first outer peripheral cylinder and the second outer peripheral cylinder are constructed such that the detected magnetic flux flows between them, and the magnetic sensor means is disposed such that the detected magnetic flux passes through, and

wherein a first magnetic field varying means and a third magnetic field varying means are disposed on an inner periphery of the first outer peripheral cylinder, and a second magnetic field varying means and a fourth magnetic field varying means are disposed on an inner periphery of second outer peripheral cylinder.

Claim 7 (Original): The torque sensor of claim 6, wherein
each of the first, second, third and fourth magnetic field varying means includes inner peripheral magnetic poles that rotate together with the first rotary shaft and outer peripheral magnetic poles that oppose the inner peripheral magnetic poles,
the outer peripheral magnetic poles of the first and third magnetic field varying means are disposed on an inner peripheral surface of the first outer peripheral cylinder, and
the outer peripheral magnetic poles of the second and fourth magnetic field varying means are disposed on an inner peripheral surface of the second outer peripheral cylinder.

Claim 8 (Original): The torque sensor of claim 6, wherein
first beveled magnetic pole plates and second beveled magnetic pole plates that extend in a direction beveled a predetermined angle with respect to the common axial line are disposed on the inner peripheries of the first outer peripheral cylinder and the second outer peripheral cylinder,
the first magnetic field varying means and the third magnetic field varying means are constructed using the first beveled magnetic pole plates, and
the second magnetic field varying means and the fourth magnetic field varying means are constructed using the second beveled magnetic pole plates.

Claim 9 (Currently amended): The torque sensor of claim 5, wherein the magnetic sensor means is fixed such that it does not move even if the ~~first outer peripheral cylinder and the second outer peripheral cylinder~~ cylinders rotate.

Claim 10 (Currently amended): The torque sensor of claim 1, wherein the magnetic sensor means includes first and second magnetic sensors, each of these magnetic sensors detects the ~~detected~~ detection portion of magnetic flux ~~flowing along the common axial line from the magnetic field generating means~~ and generates an output signal whose polarity changes in response to the relative direction of the ~~detected~~ detection portion of magnetic flux and whose magnitude changes in response to the magnitude of the ~~detected~~ detection portion of magnetic flux.

Claim 11 (Original): The torque sensor of claim 1, wherein the torque sensor also detects, in addition to the torsional torque, the rotation angle of the second rotary shaft on the basis of the output signal of the magnetic sensor means.

Claim 12 (Currently Amended): The torque sensor of claim 1, wherein the magnetic sensor means includes first and second magnetic sensors, wherein when each of these magnetic sensors detects the ~~detected~~ detection portion of magnetic flux ~~flowing along the common axial line from the magnetic field generating means~~, the output of the first magnetic sensor includes a first signal component that periodically changes in accompaniment with the rotation of the second rotary shaft, and the output of the second magnetic sensor includes a second signal component of the opposite phase of the first signal component in accompaniment with the rotation of the second rotary shaft.

Claim 13 (Original): The torque sensor of claim 1, further comprising rotation angle detecting means that detects the rotation angle of the second rotary shaft.

Claim 14 (New): A torque sensor where a first rotary shaft and a second rotary shaft are disposed on a common axial line, with the first rotary shaft and the second rotary shaft being coupled together by a torsion bar, and which detects torsional torque applied between the first rotary shaft and the second rotary shaft, the torque sensor comprising:

a magnetic configured to generate a magnetic field in a radial direction around the common axial line;

magnetic field varying means that includes first, second, third, and fourth magnetic field varying components disposed along the common axial line;

first and second outer peripheral cylinders of magnetic material, said first outer peripheral cylinder is disposed to surround the first and third magnetic field varying components, said second outer peripheral cylinder is disposed to surround the second and fourth magnetic field varying components, said first and second outer peripheral cylinders being configured so as to vary a relative direction and magnitude of a detection portion of magnetic flux from the magnetic and the intermediate cylinder flowing between the first and second outer cylinders along an axis parallel to the common axial line in response to the relative rotation between the first rotary shaft and the second rotary shaft; and

a magnetic sensor configured to detect the detection portion of magnetic flux,

wherein the magnetic sensor is further configured to generate an output signal whose polarity changes in response to the relative direction of the detection portion of magnetic flux and whose magnitude changes in response to the magnitude of the detection portion of magnetic flux.

Claim 15 (New): The torque sensor of claim 14, wherein the magnetic sensor is disposed between the first outer peripheral cylinder and the second outer peripheral cylinder along the axis parallel to the common axial line such that the detection portion of magnetic flux passes directly through the magnetic sensor.

Claim 16 (New): The torque sensor of claim 14, wherein each of the first, second, third, and fourth magnetic field varying components includes an inner peripheral magnetic pole rotated together with the rotary shaft and an outer magnetic pole rotated together with the first and second outer peripheral cylinders,

the outer peripheral magnetic poles of the first and third magnetic field components being disposed on an inner peripheral surface of the first one of the outer peripheral cylinders, and

the outer peripheral magnetic poles of the second and fourth magnetic field varying components being disposed on an inner peripheral surface of the second one of the outer peripheral cylinders.

Claim 17 (New): The torque sensor of claim 14, wherein one of the first outer peripheral cylinder and the second outer peripheral cylinder includes concave portions and convex portions in one end thereof.